

4 December 1984

MEMORANDUM FOR: Members of the Office of Training and  
Education Curriculum Committee

FROM:

Chief, Topical Issues Branch

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SUBJECT: Curriculum Committee New Course Checklist

1. The Topical Issues Branch (TIB) is planning to conduct a three-day course titled "Introduction to Nuclear Power and Radiation" during the period of 15-17 January 1985, in the Chamber of Commerce Building. The objective of this course is to provide an understanding of the basic design and operation of nuclear power plants. This course fits into a series of scientific and technologically oriented courses and seminars conducted by TIB primarily for DI and DS&T analysts.

2. Two months ago, OSWR asked TIB to consider conducting this course. Since then, other offices in the DI, DO, and DS&T have joined the list of customers.

3. Students will be professionals of all grades from throughout the Intelligence Community ---NSA, DIA, DOE--- who, because of their analytic and collection responsibilities require an understanding of nuclear power plants and how they operate.

4. The purpose of this course is to provide the layperson with an introduction to the terminology, process, and equipment involved in generation of nuclear power. An outline of the course is provided in Attachment A. The method of instruction includes two and one half days of unclassified lecture and discussion augmented by slides and viewgraphs of actual equipment and facilities. The last half of the third day will include classified discussions conducted by OSWR experts.

5. The course will be conducted by members of the Reactor Training Staff of the Nuclear Regulatory Commission's (NRC) Reactor Training Center. The course outline has been reviewed by members of TIB, and in our judgment, the course provides a comprehensive understanding of nuclear power plant design and operation.

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6. The course will be conducted by NRC instructors at no cost to the Agency. The course administration will require an estimated two man-weeks of TIB instructor -- [redacted] - and training assistant -- [redacted] -- time. A room has been reserved in the Chamber of Commerce Building for the course. We have not identified any opportunity costs associated with conducting this course.

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7. A considerable amount of informal marketing of the course has already taken place through the Nuclear Energy Division of OSWR. We will distribute an "OTE Special Training Bulletin" to all Agency training officers --- and interested parties elsewhere in the Intelligence Community.

8. We will ask each student to evaluate critical segments of the course. If student responses indicate that this pilot running of the course was useful, we will include the course in a survey of needs for specific seminars and determine how often we should run the course.

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## INTRODUCTION TO NUCLEAR POWER AND RADIATION

### COURSE OUTLINE

#### DAY 1 (Morning)

##### 1. POWER GENERATION - OVERVIEW

- a. Comparison of electrical generation from nuclear power plants to that of fossil and hydroelectric plants. Explanation of what makes a nuclear plant unique.
- b. Explanation of BWR, PWR and HTGR power generation systems.
- c. Explanation of waste heat from fossil and nuclear plants.
- d. Explanation of cooling towers and water vapor discharges.
- e. Brief discussion of the layout of a typical nuclear power plant.

##### 2. FISSION PROCESS AND HEAT PRODUCTION

- a. Review of atomic structure (elements, compounds), and electrostatic forces.
- b. Explanation of nuclear force, neutrons as part of atomic structure, and isotopes of various elements.
- c. Explanation of uranium isotopes, fission and heat production.
- d. Explanation of criticality, neutron behavior in the reactor, neutron leakage, and moderator and fuel properties that affect the fission process.
- e. Description of the use of neutron poisons (control rods, soluble boron) in controlling fission rate and thus heat output of the reactor.

#### DAY 1 (Afternoon)

##### 3. BWR PLANT SYSTEMS

- a. Description of BWR components, coolant systems and containments.
- b. Description of BWR Steam, Condensate and Feedwater Systems.

DAY 1 (Afternoon) Continued

4. PWR PLANT SYSTEMS

- a. Description of PWR components, coolant systems and containments.
- b. Comparison of PWR Secondary System to BWR Steam, Condensate and Feedwater Systems.
- c. Description of a typical Chemical and Volume Control System (PWR) (BWR).
- d. Description of a typical Residual Heat Removal System (PWR) (BWR).
- e. Description of refueling operations at a PWR.

DAY 2 (Morning)

5. INTRODUCTION TO RADIATION TERMINOLOGY  
DESCRIPTION OF:

- a. Radioactivity
- b. Radiation
  - Alpha
  - Beta
  - Gamma
  - X-Ray
  - Neutron
- c. Half Life
- d. Ionization
- e. Dose
  - Roentgen
  - Rad
  - Rem
- f. Dose Rate
- g. Stay Time
- h. Contamination (types & properties)

DAY 2 (Morning) Continued

6. SOURCES OF RADIATION

- a. Explanation and demonstration of natural and manmade radiation and its sources:

Cosmic	Medical
Terrestrial	Electronic
Internal	Weapons Testing

- b. Explanation of sources and types of radiation at a nuclear power plant.

Fuel decay  
Fission process  
Fission product decay  
Activation products  
Calibration sources

- c. Introduction to fission product barriers at a nuclear plant and their importance to public health and safety.

Fuel Pellet Construction  
Fuel Cladding Integrity  
Coolant System Integrity  
Containment Integrity

7. BIOLOGICAL EFFECTS OF RADIATION

- a. Explanation of effects of radiation exposure at the cellular level.
- b. Discussion of possible cellular processes after exposure.
- c. Discussion of radiation effects as seen at the body level.

Acute Effects  
Radiation Syndrome  
Chronic Effects  
Types of cancer related to radiation exposure.

- d. Discussion of NRC dose limits.

Unrestricted Areas  
Restricted Areas  
ALARA Program

DAY 2 (Morning) Continued

- e. Discussion of Radiosensitivity and its determining factors.
- f. Discussion on Methods of Protection against Radiation (with examples).
- g. Discussion on Methods of Protection against Contamination.

DAY 2 (Afternoon)

8. RADIOACTIVE WASTE HANDLING SYSTEMS

- a. Liquid Radwaste System
- b. Gaseous Radwaste System
- c. Solid Radwaste System

9. REACTOR EMERGENCIES

- a. Discussion of what constitutes a Reactor Emergency and the difference between a Reactor Emergency and a Radiological Emergency.
- b. Description of Design Basis Accidents and possible consequences.
  - Loss of Coolant
  - Steam Line Break
  - Rod Ejection
  - Steam Generator Tube Rupture
- c. Discussion of systems designed to mitigate Reactor Emergencies and protect the public.
- d. Normal Core Cooling and Moderating Systems
  - Aux Feedwater System
  - Steam Relief Valves
  - Residual Heat Removal System
  - Service Water System
- e. Emergency Core Coolant and Moderating Systems
  - Active Safety Injection Systems
  - Passive Safety Injection Systems

DAY 3 (Morning)

f. Containment Systems

Structure/Construction  
Depressurization and Air Cooling Systems  
Purification Systems  
Isolation Systems

g. Emergency Preparedness Systems

Licensee's Responsibility  
Local Government Responsibility  
State Government Responsibility  
Federal Response/Assistance Agencies

h. The Three Mile Island Accident

Discussion of events at TMI utilizing information  
presented in previous lectures.

10. Questions, comments, critique.